



## Additions to the flora of northern Asia: alien vascular plant records in the Yamal-Nenets Autonomous District (Russia)

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### Abstract

The north of Western Siberia has seen intensive economic development. Exploration and mining for mineral resources, active road and pipeline construction, urban development, and agriculture favor invasion and dispersal of alien plant species across the Subarctic region. The paper reports new records for eight alien species and hybrids previously unknown from northwest Siberia and the flora of northern Asia: *Alopecurus geniculatus* L., *Anthyllis vulneraria* L. subsp. *vulneraria*, *Aquilegia atrata* W.D.J. Koch, *A. vulgaris* L., *Epilobium franciscanum* Barbey, *Galium album* Mill. subsp. *album*, *Petunia atkinsiana* (Sweet) D. Don ex W.H. Baxter, *Primula elatior* (L.) Hill. These species were spotted in 2012–2014 in the towns of Salekhard, Nadym, Novy Urengoy, Tarko-Sale, Gubkinsky, and Noyabrsk in the Yamal-Nenets Autonomous District, Western Siberia (Russia). Species, synonyms, overall distribution, habitat preferences, and species taxonomy with remarks on identification and differentiation from the most similar taxa occurring in the study area, as well as the list of localities are presented.

### Keywords

Alien species, chorology, geography of plants, taxonomy, Western Siberia, new records.

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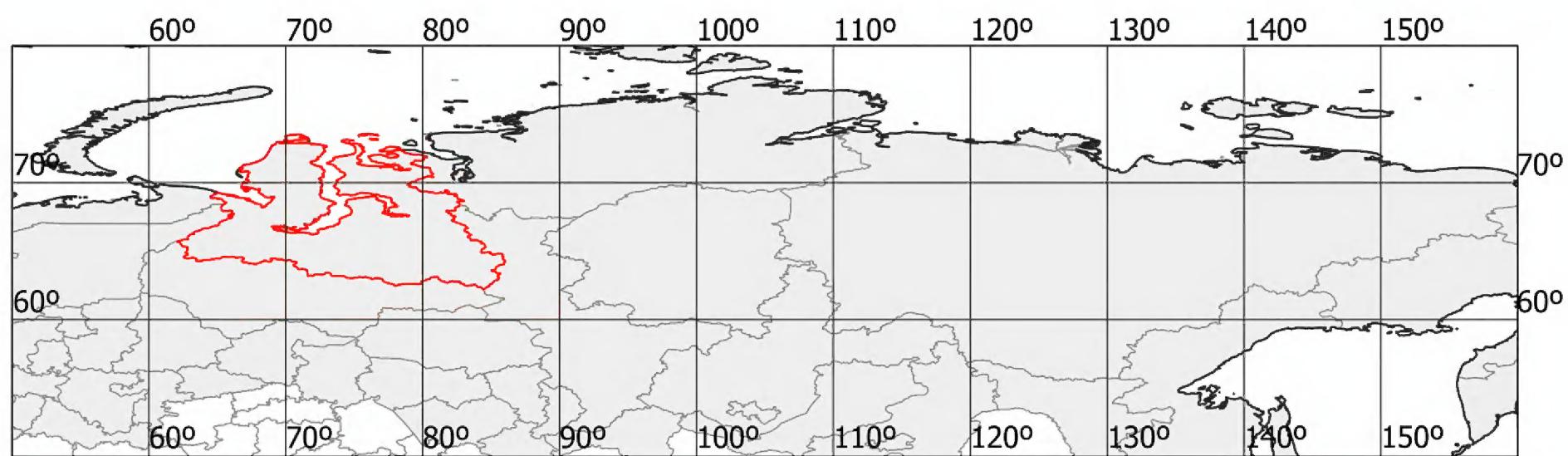
## Introduction

Flora inventories carried out in the Yamal-Nenets Autonomous District (Russia) (Fig. 1) over the past decade have detected several species new for the north part of West Siberia (Byalt et al. 2017). Most of these species are alien, even for northern Asia within Siberia (Polozhij and Malyshev 1988; Baikov 2012). They were not mentioned in earlier general floristic synopses for this territory (Baikov 2005, 2012) or in the latest sources. Currently,

1065 species of vascular plants have been recorded from the Yamal-Nenets Autonomous District, and 190 of them are alien (Pismarkina et al. 2018).

Natural vegetation is represented by tundra, forest-tundra and northern taiga. The alien species included herein are confined to disturbed habitats in urban areas.

The native flora of northern areas of Asian Russia, as well as the whole Russian Arctic region, has been quite well studied, but the flora of alien species still remains to be explored. There have been very few studies in



**Figure 1.** The boundaries of the Yamal-Nenets Autonomous District (outlined in red) within the northern part of Asia.

the Siberian North. At the same time, development of mining industry, active road and pipeline construction, urban development, and agriculture favor the invasion and dispersal of alien plant species.

Recently, there has been a warming of the climate, which, along with anthropogenic impacts, contributes to the penetration and invasion alien species into natural ecosystems. It can be assumed that some species may negatively impact these ecosystems. Therefore, monitoring the invasive activity of alien species is one of the important tasks for the preservation of natural biological diversity.

## Methods

Surveys were conducted in 2012–2014 as part of a large project to study the flora of the Yamal-Nenets Autonomous District. The towns of Labytnangi, Salekhard, Novy Urengoy, and Pangody are located in the forest-tundra zone; the towns of Nadym, Tarko-Sale and Gubkinsky are situated in the northern taiga subzone, and the town of Noyabrsk is in the middle taiga subzone (Fig. 2).

The following flora compendia and identification guides were used to identify specimens and determine their taxonomic status: Tutin et al. (1968, 1972, 1980, 1993); Tzvelev (1974); Pobedimova (1978); Miniaev and Akulova (1987); Polozhij and Malyshev (1988); Malyshev and Peshkova (1990); Frizen and Timokhina (1993); Kovtonyuk (1997); Tzvelev (2000); Vassiljeva (2001); Vinogradova (2004); Malyshev (2003); Krasnoborov (2006).

The status of the alien species was determined using the same flora compendia and identification guides, as well as: Vinogradova et al. (2009), Vinogradova and Kuprianov (2016), GBIF (2019).

The alien plant status was determined by the following criteria (Egorov et al. 2016): 1) an indication in the literature that the species has been introduced into the study area or a larger region encompassing the study area; 2) the species occurred only or mainly in ruderal and/or weedy habitats; 3) the species occurred in isolation from its main natural geographic range. The status of the alien species was determined to be casual, naturalized, or invasive, using the approach developed by

Pyšek et al. (2004) and which is quite widely used in Western Europe (Galasso et al. 2018). However, because our observations were made only once, the alien species status that we give might not be correct.

Specimens were deposited in the following herbaria (acronyms according to Thiers 2019): Herbarium of the Komarov Botanical Institute of the Russian Academy of Sciences, Saint-Petersburg (LE), I. P. Borodin Herbarium of the Saint-Petersburg State Forestry University, Saint-Petersburg (KFTA), and Moscow State University (MW).

The location of the plants was determined using a GPS receiver or Google Maps. All coordinates use the WGS84 standard.

The locations of the study sites Nadym district (Nadym, Pangody), Priuralsky district (Salekhard, Labytnangi), Purovsky district (Gubkinsky, Noyabrsk, Tarko-Sale, Novy Urengoy, Korotchaevo) are shown in Figure 2.



**Figure 2.** Map of the studied towns and settlements, and biogeographical zonation of the Yamal-Nenets Autonomous District. Natural zones and subzones (Larin 2004): Tundra zone: NTu – northern tundra subzone, MTu – middle tundra subzone; STu – southern tundra subzone; FTu – forest-tundra zone; Taiga zone: NTA – northern taiga subzone, MTA – middle taiga subzone.

## Results

Eight species and hybrids new for northern Asia were found in the settlements visited in 2012–2014. Species are in alphabetical order.

### *Alopecurus geniculatus* L. (Poaceae)

**New record.** Russia. Yamal-Nenets Autonomous District: Salekhard, Park Pobedy, lawn (66.5441° N, 066.6094° E), 05.VIII.2013, fr., A. Egorov, S. Golubev s.n. (KFTA).

**Alien status.** Casual.

**Identification.** *Alopecurus geniculatus* L. can be easily distinguished from the closely related *A. aequalis* Sobol. by genuflexuous awns protruding 1.12.5 mm from the spikelet and 1.2–1.7 mm anthers. *Alopecurus aequalis*, on the contrary, has straight or slightly genuflexuous awns that either do not protrude or protrude not more than 1 mm out of the spikelet; the anthers are also smaller (0.5–1.2 mm length) (Tzvelev 1971, 1976).

**Distribution and habitat.** The natural range of this species includes Europe (north to Scandinavia) and North America (Tzvelev 1971, 1974, 1976; Tutin et al. 1980). There is no information on previous records from Siberia in the literature, but GBIF (2019) provides one herbarium specimen (MW) from the Taz River in the Yamal-Nenets Autonomous District. This species was not included by Malyshev and Peshkova (1990) and Bajkov (2012). There is dubious information on its presence in the Ob river basin (Afonin et al. 2008). We suspect the record actually represents the closely related and common Siberian species, *A. aequalis*.

This species grows in wet habitats such as wet meadows, mires, lakeshores, along streams, on alluvial sands, and along roads. The new record was collected from a lawn in a Salekhard town park (Fig. 3). Probably, it had been sown with lawn grass mixture.

It is spreading outside of its main range. For example, it is known in the Arctic from the Kola Peninsula (Tzvelev 1976) and in the Far East from the Kurile Islands and Sakhalin (Voroshilov 1982).

### *Anthyllis vulneraria* L. subsp. *vulneraria* (Fabaceae)

**New records.** Russia. Yamal-Nenets Autonomous District: Nadym, Pravoberezhnyi district (former Staryi Nadym settlement), sandy wasteland near railway tracks (65.6000° N, 072.7000° E), 03.VIII.2014, fl., A. Potochin, E. Pismarkina, V. Byalt, M. Lebedeva, O. Galanina s.n. (LE, MW); the same town, road embankment near a pontoon bridge and construction site of bridge over Nadym River (65.5389° N, 072.5035° E), 16.VIII.2014, fl., E. Pismarkina s.n. (MW); Pangody settlement, sandy wasteland at western end, by Nadym–New Urengoy road (65.91216° N, 074.48849° E), 06.VIII.2014, fl., A. Potochin, E. Pismarkina, V. Byalt, M. Lebedeva s.n. (LE, MW); Cis-Ural region, Labytnangi town: road leading to a pier on Ob River, on shore of Ob River cutoff; weed

on roadside; wasteland (66.6333° N, 65.4833° E), 29.VII.2016, fl., V. Byalt 413 (LE, KFTA); near Nadym town, Nadym River left bank, meadow slope of the Nadym–Staryi Nadym road (65.5473° N, 72.7012° E), fl., O. Khitun, E. Pismarkina s.n. (MW).

**Alien status.** Naturalized.

**Identification.** The following features are characteristics for *A. vulneraria* s. str.: corolla yellow, undeveloped inflorescences usually lacking in the axils of stem leaves or they may occasionally be present but very small; stems are straight; leaves on the stem have 5 or 6 pairs of lateral leaflets; all leaflets are denuded above and hairy beneath; leaves are evenly distributed along the stem (Miniaev and Akulova 1987). These characters were found in specimens from the Yamal-Nenets Autonomous District (Figs 4, 5).

**Distribution and habitat.** This subspecies occurs in Western, Central, and Eastern Europe (Tutin et al. 1968; Cullen 1976). It is known from northwestern European Russia, where in the north its range (secondary, probably) it reaches the Murmansk Region (Miniaev and Akulova 1987); Cullen (1976) has shown that the distribution of *A. vulneraria* subsp. *vulneraria* is in the more southern and western parts of Europe. We believe that Cullen did not have enough materials from Russia.

The subspecies grows in meadows, forest glades and forest margins, preferring calcium-rich soils (Miniaev and Akulova 1987). In the north of Western Siberia it is adventive, found on roadsides and badlands.

The subspecies was found growing in large patches in near Nadym (Figs 4, 5) and Pangody, and several plants were found as far north as the town of Labytnangi.

It probably reached these areas with building materials, as almost all populations of these plants were found in industrial areas in large settlements, near the construction site of an automobile bridge and near a railway. Our record of a large population near an abandoned railway suggests that the plants have become established at the original sites of invasion and even expanded.

**Taxonomic notes.** The genus *Anthyllis* L. has relatively few species (about 60), and although Eurasian, it occurs mainly in the Mediterranean region and the number of species decreases markedly to the north and east.

In European Russia, where the genus *Anthyllis* is at its north-eastern limit of its distribution, it is only represented by the section *Anthyllis* s. str. (Miniaev and Klochkova 1977; Miniaev and Akulova 1987), which is the richest in species. Another species of *Anthyllis* in Siberia, *A. arenaria* (Rupr.) Juz., was first reported by Pyak (2005), who found it in the environs of the town of Yurgi, Kemerovo Region, in the southern part of western Siberia.

### *Aquilegia atrata* W.D.J. Koch (Ranunculaceae)

**New record.** Russia. Yamal-Nenets Autonomous District: Nadym town, on a lawn by an apartment house (65.5333° N, 072.5333° E), 03.VIII.2014, fl., fr., V. Byalt 664 (LE).



**Figure 3.** *Alopecurus geniculatus* L. Russia, Yamal-Nenets Autonomous District, Salekhard (forest-tundra in western Siberia), lawn, 05.VIII.2013, A. Egorov, S. Golubev s.n. (KFTA).



**Figure 4.** *Anthyllis vulneraria* L. subsp. *vulneraria* naturalized in the environs of Nadym, Yamal-Nenets Autonomous District (northern taiga in western Siberia), 03.VIII.2014 (orig.).

**Alien status.** Casual.

**Identification.** *Aquilegia atrata* W.D.J. Koch is closest to *A. vulgaris* L. The differences between these species are the former's smaller, dark-violet flowers, more deeply dissected leaves, and longer stamens which visibly protrude from the corolla tube. *Aquilegia atrata* differs from *A. atropurpurea* Willd. in having smaller flowers and in the color of corolla. The latter species has a dark-purple corolla (Acta Plantarum 2019).

**Distribution and habitat.** The natural geographic distribution is within central and southern Europe. It is a mountain species, living in the Alps and Apennines, where it occurs in spruce forests in ravines, and thickets of shrubs. It prefers humus-rich soils (Acta Plantarum 2019). According to our data, it is occasionally cultivated as a decorative plant in European Russia.

It was collected from a littered shady lawn near an apartment house in the town of Nadym (Fig. 6) in August 2014 and seen again in July 2016. Russian floristic surveys give information on a closely related species, *A. atropurpurea* Willd., which is distributed in the Trans-Baikal region and Chinese Manchuria (Frizen and Timokhina 1993; Malyshev 2012).

**Taxonomic notes.** The genus *Aquilegia* L. includes about 70 species distributed in the temperate zone of Eurasia,

as well as in North and Central America. Twenty-nine species are listed in the Flora of Russia (Vassiljeva 1996).

#### *Aquilegia vulgaris* L. (Ranunculaceae)

**New record.** Russia. Yamal-Nenets Autonomous District: Noyabrsk town, non-cultivated on a lawn near an apartment house on Tsoya Street (63.2105° N, 75.4653° E), 18.VIII.2013, fr., V. Byalt 317 (LE); Russia. Yamal-Nenets Autonomous District: Labytnangi, Zelyonaya Gorka, weed, running wild near buildings situated in a woodland (66.65824° N, 66.40723° E), 22.VII.2016, fr., V. Byalt 56 (LE).

**Alien status.** Casual.

**Identification.** *Aquilegia vulgaris* L. is distinguishable from the most similar species, *A. nigricans* Baumg., by its slightly dissected leaves, rounded-ovate leaflets, stems without glandular hairs, flowers which are smaller (4–5 cm in diameter) and blue or violet, or seldom pink, white, or red, and stamens which are non-protruding from the perianth. *Aquilegia nigricans* has similar leaves, but the stems are strongly pubescent with glandular trichrome; flowers are dark-violet, rather large (5–6 cm in diameter), and stamens strongly protruding from the perianth (Vassiljeva 1996). *Aquilegia nigricans* is similar to and sometimes considered a subspecies or variety of *A. vulgaris*



**Figure 5.** *Anthyllis vulneraria* L. subsp. *vulneraria* Russia, Yamal-Nenets Autonomous District, Pangody settlement, sandy wasteland at the western end, near Nadym-New Urengoy road (northern taiga in western Siberia), 06.VIII.2014, A. Potokin, E. Pismarkina, V. Byalt, M. Lebedeva s.n. (LE, MW).



**Figure 6.** *Aquilegia atrata* W.D.J. Koch Russia, Yamal-Nenets Autonomous District, Nadym (northern taiga in western Siberia), on a lawn by an apartment house, 03.VIII.2014, V.V. Byalt (LE).

(Schur 1853; Domin 1935–1936). Yet, some morphological peculiarities (strong glandular pubescence, large dark-colored flowers, long stamens protruding from the perianth), as well as ecological data (confined to limestone mountain slopes) allow *A. nigricans* to be recognized as a separate species (Vassiljeva 1996). Tutin et al. (1993) also included *A. nigricans* separate from *A. vulgaris*.

**Distribution and habitat.** The geographic range of *A. vulgaris* is in the Mediterranean, temperate, and subcontinental climate zones of Europe (Tutin et al. 1993; Vassiljeva 1996, 2001). It has escaped gardens and become naturalized in North America (Bulavkina 1937; Nold 2003), Australia, New Zealand, South America, and parts of Asia (GBIF 2019). It is widely cultivated as a decorative plant and easily runs wild in secondary habitats within settlements and sometimes is found rather far from human habitation in shady forests (Ignatov et al. 1990).

In Russia, it has a secondary range and is known as alien in the European part, the Caucasus and Ural mountains, and Far East (Gorchakovskii 1994; Vassiljeva 1996, 2001; Ryabinina and Knyazev 2009; Malyshev 2012). GBIF (2019) contains several records from the southern part of Siberia.

Our new record, consisting of germinated and mature plants, was collected from a lawn near an apartment house in Noyabrsk (Fig. 7). We also recorded a few plants growing feral around planted flowerbeds in other towns in the Yamal-Nenets Autonomous District, for example in Labytnangi, but no herbarium specimens were collected.

There are no records of this species from Siberia (Malyshev and Peshkova 1993; Malyshev 2003; Baikov 2005), but there is unpublished information that non-cultivated *A. vulgaris* grows in the University grove in the City of Tomsk, which is much further south than the Yamal-Nenets District.

#### *Epilobium franciscanum* Barbey (Onagraceae)

**New record.** Russia. Yamal-Nenets Autonomous District: Nadym Town, Zverev Street, flowerbed by the memorial “Eternal flame” (65.5380° N, 072.5169° E), 1 example, 20.VIII.2013, fl., fr., E. Pismarkina (KFTA).

**Alien status.** Casual.

**Identification.** This species can be easily distinguished from *E. ciliatum* Raf. (*E. adenocaulon* Hausskn.) by the stem which is pubescent almost down to its base, nearly blunted tip of seeds, and flowers with a brighter, pink-purple corolla located in the leaf axils. The distinctions from *E. affine* Bong. are renewal buds near the soil surface, pubescence on the lower part of stem, mid-stem leaves on short (1–5 mm long) leafstalks, intensely pink or purple corolla, and seeds that are 1.1–1.3 mm (not 1.3–1.5) long.

**Distribution and habitat.** The species has its main

range in western North America and has invaded Europe, where it was first found in Sweden. In Russia, the species is known from the northwest portion of the European part (Skvortsov 1996; Tzvelev 2000, 2007). It grows in swampy habitats, along shores and banks, and in wet meadows. An alien species, it occupies secondary habitats along roads and in settlements. We found this species in a flowerbed, where it had probably arrived together with seedlings of decorative annual plants brought in from European Russia.

This species is distributed Scandinavia, North America, and in Eastern Europe in the Baltic States (seldom near the coast), northwest Russia: Center (Ladoga-II'men': vicinity of Zelenogorsk and Toksovo), and western Siberia (Yamal-Nenets Autonomous District, Nadym town) (Fig. 8). It lives on swampy ground near springs, along shores and banks, along roads, and in settlements.

**Taxonomic notes.** This North American species was erroneously identified by Scandinavian authors (e.g. Lid 1994; Hämet-Ahti et al. 1998) as *E. glandulosum* Lehm., which was described from the Saskatchewan River, Canada. However, the true *E. glandulosum* has features such as white corolla and pubescence of capsules on the ribs only (Tzvelev 2007). European plants are closer to the amphi-Pacific *E. affine*, but they differ from it as well. Skvortsov (1995) coined a new name, *E. bergianum* A.K. Skvortsov, for this species, which originates from the name of the Botanical Garden in Stockholm where it was recorded for the first time.

Tzvelev (2007) noted that *E. bergianum* is in fact indistinguishable from the American *E. franciscanum*. According to Tzvelev (2007), the herbarium LE has three samples of *E. franciscanum* collected from the vicinity of San Francisco, California, and they are quite similar to European ones except that they have, on average, larger flowers. The description and good figure of *E. franciscanum* in Trelease's (1891) monograph on the American *Epilobium* fully match the traits of *E. bergianum*.

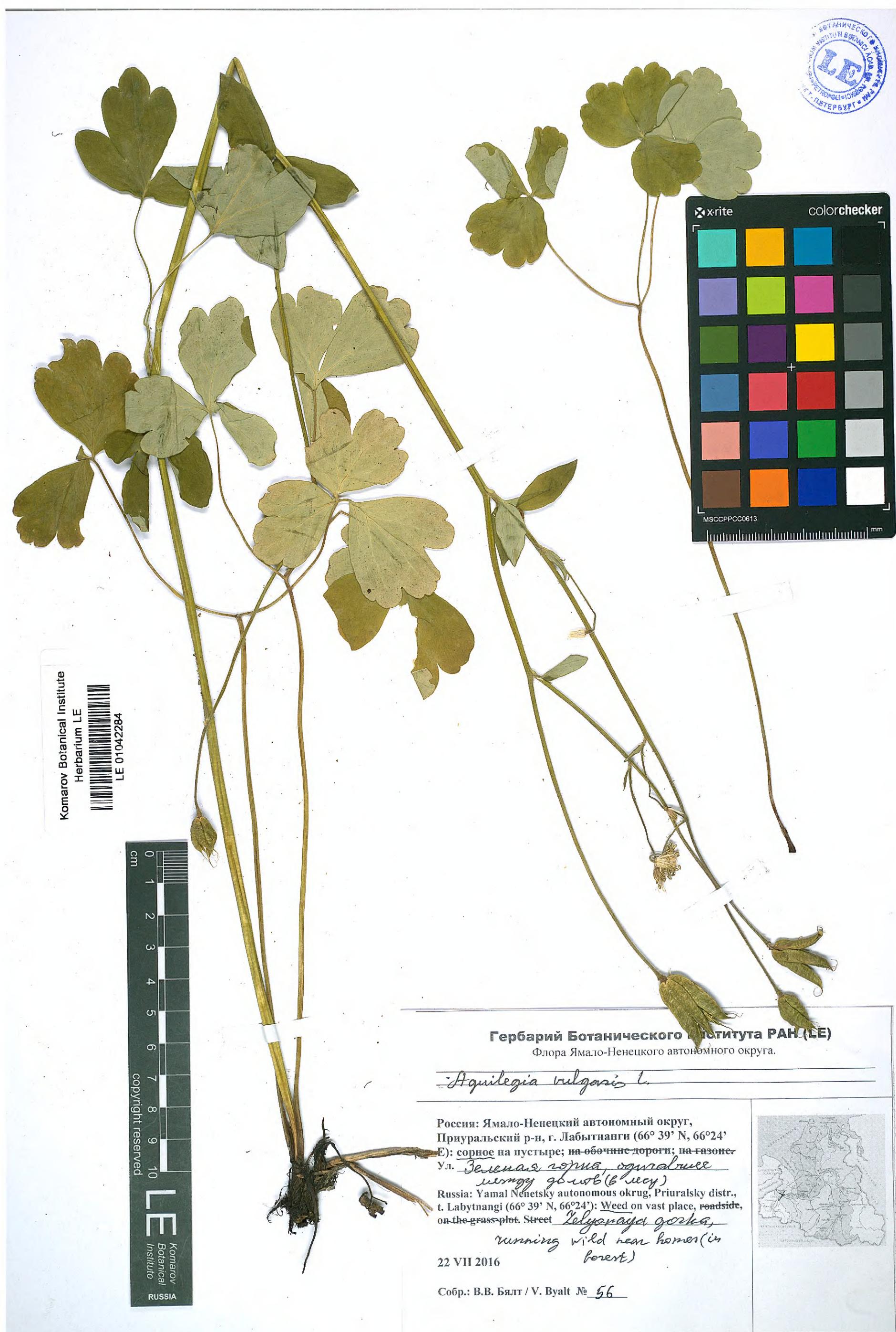
*Epilobium bergianum* differs from the polymorphic *E. ciliatum* in having wider ovate or lanceolate-ovate leaves, sessile or almost sessile mid-stem leaves, a quite large and closely adnate floral bract, denser glandular pubescence (often down to the stem base), and slightly larger and brighter-colored flowers.

In North America, *E. franciscanum* is treated as *E. ciliatum* subsp. *watsonii* (Barbey) Hoch & P. H. Raven (Plant List 2019). However, we treat it as a separate species following Skvortsov (1995) and Tzvelev (2007).

Synonyms of this species are:

*E. franciscanum* Barbey 1876 in Brewer & S. Watson, Bot. Calif. 1: 220; Tzvelev 2007, Novitates Sistem. Plant. Vasc. 39: 248.

*E. bergianum* A. Skvortsov 1995, Bull. of Moscow Soc. of Natur. Biol. Series 100, 1: 76; A. Skvortsov 1996, Fl. Part. Europ. URSS, 9: 309; Tzvelev 2000, Manual of the Vasc. Plants of NW Russ.: 465; Glazkova, Tzvelev 2006, Novit. Syst. Pl. Vasc. 38: 254, 267; L.I.



**Figure 7.** *Aquilegia vulgaris* L. Russia, Yamal-Nenets Autonomous District, Noyabrsk (middle taiga in western Siberia), non-cultivated on a lawn near a blockhouse, 18.VIII.2013, V. Byalt, N 317 (LE).



**Figure 8.** *Epilobium franciscanum* Barbey Russia, Yamal-Nenets Autonomous District, Nadym (northern taiga in western Siberia), flowerbed by the memorial "Eternal flame", 20.VIII.2013, E. Pismarkina (KFTA).

Krupkina 2006, Illustr. Identif. Keys to Pl. of Lenin-  
grad Reg.: 328, map 243.—  
*E. glandulosum* auct., non Lehman: G. Samuelsson 1918  
in Lindmann, Svensk Fanerogam fl.: 420; Marklund,  
1963, Memor. Soc. Fauna Fl. Fenn. 38: 1821; Lid,  
1963, Norsk og Svensk Fl.: 500; P.H. Raven, 1968, in  
Fl. Eur. 2: 311; Hovda, 1973, Blyttia, 31, 1: 20, 24.—

*E. ciliatum* subsp. *watsonii* (Barbey) Hoch & P.H. Raven,  
1977, Ann. Missouri Bot. Gard. 64(1): 136.

***Galium album* Mill. subsp. *album* (Rubiaceae)**

**New records.** Russia. Yamal-Nenets Autonomous District: 6 km from Gubkinsky town, roadside by a local forestry company office, on sand (64.4058° N, 076.3993°

E), 9.VIII.2013, fl., V. Byalt, S. Ivanov 51 (LE); Gubkinsky Town, weed on a sandlot by a church (64.4330° N, 076.4829° E), 10.VIII.2013, fl., V. Byalt, S. Ivanov 93 (LE, KFTA); 3) Noyabrsk town, on a lawn by a stream (63.1754° N, 75.4155° E), 16.VIII.2013, fl., V. Byalt 270 (LE); same town, on a lawn on Lenin Street, 16.VIII.2013, fl., V. Byalt 270 (LE); Nadym town, on a lawn in house yard 65.5333° N, 072.5333° E), 12–14.VIII.2014, fl., V. Byalt 40 (LE); Novy Urengoy, Korotchaevo settlement, weed on wasteland, in the yard of an auto transport company office (on lakeshore) (65.9151° N, 078.2013° E), 29.VII.2014, fl., V. Byalt, E. Pismarkina 403 (LE); Panguy settlement, on a lawn (65.8523° N, 074.4954° E), 6.VIII.2014, fl., V. Byalt, E. Pismarkina, A. Potokin, M. Lebedeva 602 (LE).

**Alien status.** Naturalized.

**Identification.** *Galium album* Mill. is very similar to *G. mollugo* L., but they are easily distinguishable. Below is a dichotomous key for their identification that helps discriminate between these two species:

- a. Stems usually ascending or suberect; panicle narrow, with short upward branches; peduncles straight when flowering, usually 1.5–3.0 mm long; flowers 2.5–4.3 mm in diameter; leaves linear lanceolate, (9) 15 (18) mm long, (1.0) 1.5 (3.0) mm wide, rather rigid, with reflexed margin . . . . . *G. album*
- b. Stems ascending or erect; panicle sprawling with long divaricate branches; peduncles divaricate when flowering, 3.0–4.0 mm long; flowers 2.5–3.5 mm in diameter; leaves linear-oblong or oblanceolate, (10) 20 (25) mm long, (1.5) 2.5 (4.0) mm wide, soft, flat . . . . . *G. mollugo*

Our specimens are undoubtedly *G. album* Mill. subsp. *album*.

**Distribution and habitat.** The geographic range of this species covers Europe, the Urals, Asia Minor, and North America (Tutin et al. 1972; Pobedimova 1978; Gorshakovskii 1994; Ryabinina and Knyazev 2009; GRIN 2019). There are two records from the southern part of western (55.0°N, 073.3°E, June 2019) and central Siberia (54.1°N, 084.8°E, July 2012) (GBIF 2019).

*Galium album* subsp. *album* grows in all types of forests, in forest glades, forest openings, in steppes and meadows, shrub thickets, on stony placers, and along the shores of ponds and streams. In secondary habitats (settlements, gardens, fallows, and wastelands), it grows as a weed.

We collected plants (Fig. 9) on roadsides, in lawns, and on wastelands. In 2015–2016, we recorded this subspecies in Nadym town and some other places, but in secondary habitats only. It had probably been introduced to these areas via automobile and railway transport together with lawn grass mixtures.

#### *Petunia atkinsiana* (Sweet) D. Don ex W.H. Baxter (Solanaceae)

**New record.** Russia. Yamal-Nenets Autonomous District: Noyabrsk town, on an abandoned ruderal lawn

(without flowerbeds) near a children's clinic (63.1975° N, 075.4576° E), 16.VIII.2013, fl., V. Byalt 303 (LE).

**Alien status.** Casual.

**Identification.** This species, known as garden petunia, is a herbaceous, perennial plant, which grows to about 60 cm tall. It is most commonly cultivated as an annual and is a very common plant in flower gardens; there are hundreds of named varieties. Most of petunias sold for home gardens are this nothospecies, a hybrid created from the wild parents *P. axillaris* (Lam.) Britton, Sterns & Poggenb. and *P. inflata* R.E. Fr. (Bombarely et al. 2016).

**Distribution and habitat.** *Petunia atkinsiana* is widely cultivated as a decorative plant, and in northern Siberia, it is raised from seedlings grown in local greenhouses or transported in from the south. In European Russia it sometimes grows on wastelands and as a weed in lawns; self-seeding are known (Mayorov et al. 2012).

We collected this species from an abandoned lawn in Noyabrsk town (Fig. 10). No cultivated plants were present nearby. There was a random spread of seeds. In the summer 2016, Petunia feral plants were noticed on a wasteland in Salekhard town.

**Taxonomic notes.** Species of *Petunia* Juss. have been cultivated since the 18th century. In popular literature this species is usually named *P. hybrida* (Hook.) E.Vilm. The name *P. hybrida* was published (Vilmorin 1863) as a new combination based on *P. violacea* Lindl. var. *hybrida* Hook., *P. atkinsiana* (as *Nierembergia atkinsiana* Sweet (1834)) has priority (Shaw 2000). Although *Nierembergia atkinsiana* was described as a species, Sweet knew that it was a garden hybrid. We believe this name is suitable for a great number of *Petunia* cultivars in Russia and Europe.

Synonyms are:

*Petunia atkinsiana* (Sweet) D. Don ex W.H. Baxter, 1839, in Loudon, Hort. Brit., ed. 3 (Hort. Brit. Suppl., 2): 655.

*Nierembergia atkinsiana* Sweet, 1834, Brit. Fl. Gard. 6: tab. 268.

≡ *Nicotiana × atkinsiana* (Sweet) Kuntze, 1898, Revis. Gen. Pl. 3 [3]: 223.

≡ *Petunia violacea* var. *hybrida* Hooker, 1837, Bot. Mag. 64: pl. 3556.

≡ *Petunia hybrida* (Hook.) E. Vilmorin-Andrieux, 1863, Fl. Pleine Terre: 615.

There are other named hybrids of *Petunia*, usually with uncertain parental species, which are probably later synonyms of *Petunia atkinsiana* (Sweet) D. Don ex W.H. Baxter.

#### *Primula elatior* (L.) Hill (Primulaceae)

**New record.** Russia. Yamal-Nenets Autonomous District: Labytnangi town, Arctic Research Station of the Institute of Plant and Animal Ecology of the Ural Branch of the Russian Academy of Sciences, lawn, forbs and low-grass meadow (66.6582° N, 066.4072° E), 03.VIII.2013, fr., A. Egorov, S. Golubev s.n. (KFTA).



**Figure 9.** *Galium album* Mill. subsp. *album* Russia, Yamal-Nenets Autonomous District, Novy Urengoy, Korotchaev settlement (forest-tundra in western Siberia), weed on wasteland, 29.VII.2014, V. Byalt, E. Pismarkina 403 (LE).



**Figure 10.** *Petunia atkinsiana* (Sweet) D. Don ex W.H. Baxter. Russia, Yamal-Nenets Autonomous District, Noyabrsk (middle taiga in western Siberia), on abandoned ruderal lawn (without flowerbeds), 16.VIII.2013, fl., V. Byalt 303 (LE).

**Alien status.** Casual.

**Identification.** This species differs from the related *P. veris* L. in having glabrous, slightly pubescent, non-crinkled leaves with very short leafstalks. *Primula elatior*, on the contrary, has strongly crinkled leaves, with veins pressed in and protruding below, on well-developed leafstalks, and the whole plant is densely pubescent (Fedorov 1981).

**Distribution and habitat.** The geographic range of this species is in southern and central Europe and Scandinavia (Tutin et al. 1972). It is associated with deciduous forest margins and grows in meadows at the foot of hills and on hill slopes (Fedorov 1981). It is sometimes cultivated as a decorative plant in parts of Russia. We collected this species in Labytnangi where it was found in a meadow (Fig. 11) at the Arctic Research Station of Institute of Plant and Animal Ecology of the Ural Branch of the Russian Academy of Sciences. The sampled plants had obviously escaped culture.

**Taxonomic notes.** *Primula elatior* (L.) Hill is placed in the section *Primula* (Fedorov 1981). *Primula elatior* is a vicariad of *P. pallasii* Lehm. (Kovtonyuk 1997, 2012), which was described by Lehmann from the Altai region and occurs in the south of western and eastern Siberia, southeast Kazakhstan, the Caucasus, and Asia Minor. In Eastern Europe it occurs only in the central Urals, but *P. elatior* is a European endemic, and it had not been previously reported from Siberia.

## Discussion

We provide new information on eight alien species and hybrids in northern Asia and not previously reported in the literature from Siberia. We conclude that the arrival of alien species (Byalt et al. 2017) in the Yamalo-Nenets Autonomous District is due to the growing human influence on the region's ecosystems. The regional flora is becoming increasingly synanthropic and enriched with alien species, which mainly occupy newly created anthropogenic habitats in urban areas and along transport routes. These species enter the region mainly from the south and southwest. The increasing numbers of alien species is directly caused by the intensified economic activities. The alien taxa reported here have settled exclusively in anthropogenic habitats and have not penetrated the taiga, tundra, or wetland ecotopes. But as the transport network is developed, alien plants are penetrating farther north into the forest-tundra and even the tundra zone (alien species have been detected on the Yamal Peninsula in the northernmost part of the district; Rebristaya 2013; Pismarkina 2014; Pismarkina and Byalt 2016). We mainly observed occasional arrivals in the region, for example: *Alopecurus geniculatus*, *Aquilegia atrata*, and *Primula elatior*. However, some of the taxa, such as *Anthyllis vulneraria* subsp. *vulneraria* and *Galium album* subsp. *album*, were found to be widely distributed in disturbed habitats. Apparently, naturalization in these

communities is a continuous process.

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## Authors' Contributions

The authors made an equal contribution to the creation of the article. The authors declare that they have no conflict of interest.

## References

- Acta Plantarum (2019) *Aquilegia atrata* W.D.J. Koch. <http://www.actaplantarum.org/floraitaliae/viewtopic.php?t=5683>. Accessed on: 2019-12-6.
- Afonin AN, Greene SL, Dzyubenko NI, Frolov AN (Eds) (2008) Interactive agricultural ecological atlas of Russia and neighboring countries. Economic plants and their diseases, pests and weeds. <http://www.agroatlas.ru/en>. Accessed on: 2019-12-6.
- Baikov KS (Ed.) (2005) *Conspectus florae Sibiriae: plantae vasculares*. Russian Academy of Sciences, Siberian Branch, Novosibirsk, 361 pp. [in Russian].
- Baikov KS (Ed.) (2012) *Conspectus florae Rossiae Asiaticae: plantae vasculares*. Siberian Branch of the Russian Academy of Sciences, Novosibirsk, 630 + [9] pp. [in Russian].
- Baxter WH (1839) *Petunia atkinsiana*. In: Loudon BC (Ed.) Loudon's Hortus Britannicus. Ed. 3 (Hortus Britannicus Supplement 2). Longman, Rees, Orme, Brown, and Green & Longman, London, 655 pp.
- Bombarely A, Moser M, Amrad A et al. (2016) Insight into the evolution of the Solanaceae from the parental genomes of Petunia hybrid. *Nature Plants* 2 (16074): 1–9. <https://doi.org/10.1038/nplants.2016.74>
- Bulavkina AA (1937) Genus *Aquilegia* L. In: Komarov VL (Ed.), *Flora of the USSR*. Vol. 7. Editio Academiae Scientiarum URSS, Moscow/Leningrad, 86–99 [in Russian].
- Byalt VV, Pismarkina EV, Egorov AA (2017) New records of alien vascular plant species in the Yamalo-Nenets autonomous district. *Botanicheskyi Zhurnal* 102 (12): 1663–1682 [in Russian].
- Cullen J (1976) The *Anthyllis vulneraria* complex: a résumé. Notes of the Royal Botanic Gardens of Edinburgh 35 (1): 1–38.
- Domin K (1935–1936) *Aquilegia vulgaris* L. In: *Plantarum Čechoslovakiae enumeratio*. Preslia 13: 80.
- Ebel AL (2013) On the distribution of *Epilobium pseudorubescens*



**Figure 11.** *Primula elatior* (L.) Hill Russia, Yamal-Nenets Autonomous District, Labytnangi (forest-tundra in western Siberia), lawn, forbs and low-grass meadow, 03.VIII.2013, A. Egorov, S. Golubev (KFTA)

(Onagraceae) in Siberia. *Turczaninowia* 16 (3): 112–115 [in Russian]. <https://doi.org/10.14258/turczaninowia.16.3.18>

Egorov A, Byalt V, Pismarkina E (2016) Alien plant species in the north of western Siberia. In: UArctic Congress 2016. St. Petersburg, Russia, 105.

Fedorov AA (1981) Fam. Primulaceae Vent. In: *Flora partis Europaea URSS*. Vol. 5. USSR Academy of Sciences, Leningrad, 63–87 [in Russian].

Frizen NV, Timokhina NV (1993) Familia Ranunculaceae. In: *Flora Sibiriae*. Vol. 6. Russian Academy of Sciences, Novosibirsk, 99–208 [in Russian].

Galasso G, Conti F, Peruzzi L, Ardenghi NMG, Banfi E, Celesti-Grapow L, Albano A, Alessandrini A, Bacchetta G, Ballelli S, Bandini Mazzanti M, Barberis G, Bernardo L, Blasi C, Bouvet D, Bovio M, Cecchi L, Del Guacchio E, Domina G, Fascetti S, Gallo L, Gubellini L, Guiggi A, Iamónico D, Iberite M, Jiménez-Mejías P, Lattanzi E, Marchetti D, Martinetto E, Masin RR, Medagli P, Passalacqua NG, Peccenini S, Pennesi R, Pierini B, Podda L, Poldini L, Prosser F, Raimondo FM, Roma-Marzio F, Rosati L, Santangelo A, Scoppola A, Scortegagna S, Selvaggi A, Selvi F, Soldano A, Stinca A, Wagensommer RP, Wilhalm T, Bartolucci F (2018) An updated checklist of the vascular flora alien to Italy. *Plant Biosystems* 152 (3): 556–592.

GBIF (Global Biodiversity Information Facility) (2019) <https://www.gbif.org>. Accessed on: 2019-12-6.

Glazkova EA, Tzvelev NN (2006) De plantarum speciebus raris et criticis in insula Kotlin (sinus Fennicus) crescentibus. *Novitiae Systematicae Plantarum Vascularium* 38: 251–270 [in Russian].

Gorchakovskii PL (Ed.) (1994) Manual of vascular plants of Middle Ural. Russian Academy of Sciences, Ural Branch, Moscow, 524 pp. [in Russian].

GRIN (Germplasm Resources Information Network) (2019) <https://www.ars-grin.gov>. Accessed on: 2019–12–6.

Hämet-Ahti L, Suominen J, Ulvinen T, Uotila R (Eds) (1998) *Retkeilykasvio* (Field Flora of Finland), Ed. 4. Finnish Museum of Natural History, Botanical Museum, Helsinki, 656 pp.

Hoch PC, Raven PH (1977) New combinations in *Epilobium*. *Annales of Missouri Botanical Garden* 64 (1): 136.

Hooker W (1837) *Petunia violacea* var. *hybrida*. The Botanical Magazine 64: pl. 3556.

Hovda JT (1973) The American species of the genus *Epilobium* found in Norway. *Blyttia* 31 (1): 20, 24.

Ignatov MS, Makarov VV, Bochkin VD (1990) On naturalization of adventive species in Moscovskaya province. *Botanicheskyi Zhurnal* 73 (3): 438–442 [in Russian].

Kovtonyuk NK (1997) Familia Primulaceae. In: *Flora Sibiriae*. Vol. 11. Russian Academy of Sciences, Novosibirsk, 30–47 [in Russian].

Kovtonyuk NK (2012) Familia Primulaceae Batsch ex Borkh. In: *Conspectus florae Rossiae Asiaticae: plantae vasculares*. Siberian Branch of the Russian Academy of Sciences, Novosibirsk, 130–138 [in Russian].

Krasnoborov IM (Ed.) (2006) Manual of plants of Khanty-Mansi autonomous district. Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Ekaterinburg, 304 pp. [in Russian].

Krupkina LI (2006) *Epilobium* L. In: Budantsev AL, Yakovlev GP (Eds) Illustrated identification keys to plants of Leningrad Region. KMK Scientific Press, Moscow, 324–329, map 243 [in Russian].

Kuntze O (1898) *Nicotiana × atkinsiana*. In: *Revis. Revisio generum plantarum: vascularium omnium atque cellularium multarum secundum leges nomenclaturae internationales cum enumeratione plantarum exoticarum in itinere mundi collectarum*. Vol. 3 [pt 3]. A. Felix [etc.], Leipzig, 223.

Larin SI (Ed.) (2004) Atlas of the Yamal-Nenets autonomous district. Omsk, 304 pp. [in Russian].

Lid J (1963) *Norsk og Svensk Flora*. Det Norske Samlaget, Oslo, 800 pp.

Lid J (1994) *Norsk Flora*. Norske Samlaget, Oslo, 1014 pp.

Mayorov SP, Bochkin VD, Nasimovich YuA, Scherbakov AV (2012) Adventive flora of Moscow and the Moscow region. Partnership of scientific publications of KMK, Moscow, 412 pp., + 120 pp. col. ills.. [in Russian].

Malyshev LI (Ed.) (2003) *Flora Sibiriae. Additamenta et corrigenda. Indices alphabetici*. Vol. 14. Russian Academy of Sciences, Novosibirsk, 186 + [1] pp. [in Russian].

Malyshev LI (2012) *Familia Ranunculaceae* Juss. In: Baikov KS (Ed.), *Conspectus florae Sibiriae: plantae vasculares*. Russian Academy of Sciences, Siberian Branch, Novosibirsk, 31–55 [in Russian].

Malyshev LI, Peshkova GA (Eds) (1990) *Flora Sibiriae*: in 14 tomis. Vol. 2. USSR Academy of Sciences, Novosibirsk, 359 pp. [in Russian].

Malyshev LI, Peshkova GA (Eds) (1993) *Flora Sibiriae*: in 14 tomis. Vol. 6. Russian Academy of Sciences, Novosibirsk, 309 pp. [in Russian].

Marklund J (1963) *Epilobium glandulosum* Lehm. i Finland och på Karelska näset. *Memoires Societatis Fauna Flora Fennicae* 38: 1821.

Miniaev NA, Akulova ZV (1987) Genus *Anthyllis* L. In: *Flora partis Europaea URSS*. Vol. 6. USSR Academy of Sciences, Leningrad, 98–103 [in Russian].

Miniaev NA, Klochkova ZV (1977) De genere *Anthyllis* L. (Fabaceae). In: *Parte Europaea URSS. Novitates Systematicae Plantarum Vascularium* 14: 140–152 [in Russian].

Nold R (2003) *Columbines: Aquilegia, Paraquilegia, and Semiaquilegia*. Timber Press, Portland, 194 pp.

Pismarkina EV (2014) Records of alien vascular plants on Yamal Peninsula. *Bulletin of Moscow Society of Naturalists. Biological series* 119 (3): 75–76 [in Russian].

Pismarkina EV, Byalt VV (2016) Materials for the study of biodiversity in the Yamalo-Nenets Autonomous District: vascular plants of the Nuny-Yaha river basin. *Vestnik of Orenburg State Pedagogical University* 1: 49–69 [in Russian].

Pismarkina EV, Byalt VV, Khitun OV, Bystrushkin AG, Egorov AA (2018) Alien species of American origin in flora of the Yamalo-Nenets autonomous district (Russia, Tyumen region). In: *Ecology and geography of plants and plant communities: proceedings of the IV International Scientific Conference*. Ural Publishing House, Ekaterinburg, 694–698 [in Russian].

Plant list (2019) <http://www.theplantlist.org>. Accessed on: 2019-12-6.

Pobedimova EG (1978) Fam. Rubiaceae Juss. In: *Flora Partis Europaea URSS*. Vol. 3. USSR Academy of Sciences, Leningrad/Moscow, 88–118 [in Russian].

Polozhij AV, Malyshev LI (Eds) (1988) *Flora Sibiriae*: in 14 tomis. Vol. 8. USSR Academy of Sciences, Novosibirsk, 199 pp. [in Russian].

Pyak AI (2005) *Anthyllis arenaria* (Rupr.) Juz.—a new adventive genus and species of the Siberian flora. In: *Systematic Notes on the Materials of P.N. Krylov Herbarium of Tomsk State University* 95: 31–32 [in Russian].

Pyšek P, Richardson DM, Rejmánek M, Webster GL, Williamson M, Kirschner J (2004) Alien plants in checklists and floras: towards better communication between taxonomists and ecologists. *Taxon* 53: 131–143.

Raven PH (1968) *Epilobium* L. In: Tutin TS, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA (Eds) *Flora Europaea: Rosaceae to Umbelliferae*. Vol. 2. Cambridge University Press, London, 308–311.

Rebristaya OV (2013) Flora of the Yamal Peninsula. St. Petersburg, 312 pp. [in Russian].

Ryabinina ZN, Knyazev MS (2009) Manual of vascular plants of Orenburgskaya Province. KMK Scientific Press, Moscow, 758 pp. [in Russian].

Samuelsson G (1918) *Epilobium* L. In: Lindman CAM (Ed.) *Svensk Fanerogam flora*. Stockholm, 420.

Schur F (1853) *Aquilegia* In: *Sertum florae Transsilvaniae sive enumeratio systeraatica omnium plantarum, quae in Transsilvania sponte crescunt et in usum hominum copiosius coluntur*. *Verhandlungen und Mitteilungen des siebenbürgischen Vereins für Naturwissen Schaften zu Hermannstadt* 4: 1–31.

Shaw JMH (2000) Genus *Petunia* Juss. In: *The European Garden*

Flora Editorial Committee (Eds) Cullen J, Alexander JCM, Brickell CD, Edmondson JR, Green PS, Heywood VH, Jørgensen, jury SL, Knees SG, Maxwell HS, Miller DM, Robson NKB, Walters SM, Yeo PF (Edts.). Volume 6. Dicotyledons. Cambridge University Press, Cambridge, 257–261.

Skvortsov AK (1995) Taxonomy and nomenclature of adventive *Epilobium* species in Russia. Bulletin of the Moscow Society of Naturalists, Biological series 100 (1): 74–78 [in Russian].

Skvortsov AK (1996) Fam. Onagraceae Juss. In: Flora partis Europaea URSS. Vol. 9. USSR Academy of Sciences, Leningrad, 299–316 [in Russian].

Sweet R (1834) *Nierembergia atkinsiana* Sweet. In: Sweet R, Smith ED (Eds) The British Flower Garden. Vol. 6. W. Simpkin and R. Marshall, London, tab. 268.

Thiers B (2019) Index Herbariorum: a global directory of public herbaria and associated staff. <http://sweetgum.nybg.org/ih/>. Accessed on: 2019-12-25.

Trelease W (1891) A revision of the American species of *Epilobium* occurring north of Mexico. Report Missouri Botanical Garden 2: 69–118.

Tutin TS, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb (Eds) (1968) Flora Europaea: Psilotaceae to Plantanaceae. Vol. 1. University Press, Cambridge, 467 pp.

Tutin TS, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA (Eds) (1972) Flora Europaea: Diapensiaceae to Myoporaceae. Vol. 3. Cambridge University Press, London, 415 pp.

Tutin TS, Heywood VH, Burges NA, Moore DM, Valentine DH, Walters SM, Webb DA (1980) Flora Europaea: Alismataceae to Orchidaceae (Monocotyledones) (1980) Vol. 5. Cambridge University Press, London, 503 pp.

Tutin TS, Burges NA, Chater AO, Edmondson JR, Heywood VH, Moore DM, Valentine DH, Walters SM, Webb DA (Eds) (1993) Flora Europaea: Rosaceae to Umbelliferae. Vol. 1. Second edition. Cambridge University Press, Cambridge, xxvii + 469 pp.

Tzvelev NN (1971) Genus *Alopecurus* L. in USSR. Novitates Systematicae Plantarum Vascularium 8: 12–22 [in Russian].

Tzvelev NN (1974) Fam. Poaceae (Gramineae). In: Flora Partis Europaea USSR. Vol. 1. USSR Academy of Sciences, Leningrad, 117–368 [in Russian].

Tzvelev NN (1976) Grasses of the USSR. USSR Academy of Sciences, Leningrad, 788 pp. [in Russian].

Tzvelev NN (2000) [Key to Vascular Plants of North-West Russia (Leningrad, Pskov and Novgorod provinces)]. State Chemical-Pharmaceutical Academy Press, St. Petersburg, 781 pp. [in Russian].

Tzvelev NN (2007) De genere *Epilobium* L. (Onagraceae) in Europa oriental. Novitates Systematicae Plantarum Vascularium 39: 241–259 [in Russian].

Vassiljeva IM (1996) System generis *Aquilegia* L. (Ranunculaceae) florae Rossiae et civitum confinum. Novitates Systematicae Plantarum Vascularium 30: 8–28 [in Russian].

Vassiljeva IM (2001) Genus *Aquilegia* L. In: Flora Europae Orientalis. Chemical-Pharmaceutical Academy Press, St. Petersburg 10: 183–186 [in Russian].

Vassiljeva IM (2001) The morphology of seeds and anatomical characteristics of seed coat in some species of the genus *Aquilegia* (Ranunculaceae). Botanicheskyi Zhurnal 78 (4): 67–80 [in Russian].

Vilmorin-Andrieux E (1863) *Petunia hybrida*. In: Les Fleurs de pleine terre, comprenant la description et la culture des fleurs annuelles, vivaces et bulbeuses de pleine terre. Vilmorin-Andrieux et Cie, Paris, 615.

Vinogradova VM (2004) Fam. Apiaceae Lindl. (Umbelliferae Juss.). In: Flora Europae Orientalis. Vol. 11. KMK Scientific Press, St. Petersburg, 315–437 [in Russian].

Vinogradova YK, Mayorov SR, Khorun LV (2009) Black book of flora of Central Russia (alien plant species in ecosystems of Central Russia). GEOS, Moscow, 501 pp. [in Russian].

Vinogradova YK, Kuprianov AN (Eds) (2016) The black book of the flora of Siberia. Academic publishing House Geo, Novosibirsk, 440 pp. [in Russian].

Voroshilov VN (1982) Key to plants of the Soviet Far East. USSR Academy of Sciences, Moscow, 673 pp. [in Russian].